POPULATION AND MICROHABITAT OF *Gonystylus bancanus* (Miq.) Kurz IN DANAU PULAU BESAR-DANAU BAWAH WILDLIFE SANCTUARY, SUMATRA

Populasi dan Mikrohabitat *Gonystylus bancanus* (Miq.) Kurz di Cagar Alam Danau Pulau Besar-Danau Bawah, Sumatra

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Abstrak

Ramin (*Gonystylus bancanus*) diketahui sebagai salah satu spesies penghasil kayu utama yang mengalami eksploitasi tinggi di Indonesia. Spesies ini hanya ditemukan di habitat rawa gambut yang spesifik, sehingga terbatas distribusi alaminya. Informasi mengenai kondisi populasi terkini dan karakteristik mikrohabitatnya relatif terbatas. Kami menginvestigasi populasi alam dan mikrohabitat dari ramin di kawasan rawa gambut di Provinsi Riau dengan melakukan pencacahan melalui transek acak dengan 46 (100m^2) plot sampel. Empat puluh delapan individu ditemukan dimana 46 adalah *G. bancanus*, dan dua merupakan jenis lain. Kerapatan populasi diestimasikan sebesar 7.18±2.75 individu/ha. Struktur populasi membentuk kurva J yang mengindikasikan terdapat banyak individu dewasa dengan sedikit individu sapling dan tanpa anakan. Mikrohabitat ditaksir dengan menggunakan analisis DFA dan CA, yang menunjukkan adanya dua variabel yang secara signifikan mengelompokkan tiga grup dari populasi ramin.

Kata kunci: *Gonystylus bancanus*, ramin, kerapatan, mikrohabitat, analisis fungsi pembeda, gambut

Abstract

Ramin (*Gonystylus bancanus*) is one of the major timber species that facing high exploitation in Indonesia. This species can only be found on a specific peat swamp habitat, thus it confines its distribution. Information on its current population and microhabitat characteristics is relatively limited. Here, we investigated natural population and microhabitat of ramin in a peat swamp area in Riau Province using random transects consist of 46 (100m2) sampling plots. Forty-eight individuals of ramin were found in which 46 of these belonged to *G. bancanus*, while the other two were different species. The estimated population density of ramin in this area was 7.18±2.75 individuals/ha i.e there were approximately seven individuals in each one-ha area of study. The population structure of ramin showed a J-shaped curve bearing many large old trees with few saplings without any seedlings. The microhabitat was investigated using the Discriminant Function Analysis (DFA) and Canonical Analysis, generating two significant variables that discriminated three groups of the population.

Keywords: *Gonystylus bancanus*, ramin, density, microhabitat, discriminant function analysis, peat

INTRODUCTION

Ramin which is known as a major timber species with high commercial value is derived from the genus of *Gonystylus* (Family: Thymelaeaceae). This genus comprises over 31 species, spreading throughout most of the Malesian region. The greatest diversity occurs in Borneo (around 27 species), followed by Peninsular Malaysia with six species and Sumatra with a similar number (Soerianegara and Lemmens, 1994; Lim et al., 2004). In the international trade, there are six species that commercially valuable which are under the trade name of ramin. However, *Gonystylus bancanus* (Miq.) Kurz is the famous species in the trade. Ramin (referring to *G. bancanus*) is mostly sold in the form of sawn timber; semi-finished timber products such as dowels and mouldings; and finished products such as furniture, picture frames and billiard cues (Lim et al., 2004).

The current trend toward an increasing of the international trade has resulted in over harvesting of ramin trees from the wild populations. Most of the populations were already in apprehensive situation. Since 2005, ramin has been included in CITES Appendix II (Convention on International Trade in Endangered Species of Wild Fauna and Flora), which means that the International trade of specimens of this species may be authorized by the granting of an export permit or re-export certificate from the Management Authority (CITES, 2008). According to IUCN redlist (WCMC, 1998), ramin is also regarded as vulnerable (VU A1cd).

Sumatra, the main distribution of ramin, has been suffered from high deforestation (FWI/GFW, 2002). The study in Kerinci Seblat National Park reported a total of 13.4 km2 of forest area has been cleared between 1985-1992 equivalents to a mean deforestation rate of 1.1% per year. Similar study reported that in 1992-1999, still in Sumatra a total of 32.6 km2 of forest area was loss or equivalent to a mean deforestation rate of 3% per year (Linkie et al., 2004).

Undoubted, forest degradation is the biggest contributor in decreasing the area occupancy of ramin in Sumatra. Recent study recorded, ramin populations in Sumatra were only found in several protected areas such as Giam-Siak Kecil Nature Reserve, Danau Pulau Besar/Danau Bawah Wildlife Sanctuary, Tasik Belat Wildlife Sanctuary, Tasik Sekap Wildlife Sanctuary, Bukit Batu Wildlife Sanctuary, Berbak National Park and Sembilang National Park (Bastoni, 2005; FWI, 2002).

Study about population, density, distribution and microhabitat of ramin are relatively limited. FWI (2002) reported that the density of ramin population in Sebangau Watershed, Danau Pulau Besar-Danau Bawah Wildlife Sanctuary and Tanjung Putting National Park were about 2, 3 and 17 individuals per ha, respectively. Unfortunately, further monitoring was not conducted to predict the populations dynamic. Moreover, research on the habitat characteristic of ramin were also very lack. Some research has (i.e: Tuah et al., 2000; Truong, 2005; Heriyanto & Garsetiasih, 2006; Hardi, et al., 2007) only reported general observations of the habitat types.

This paper describes the population density assessment of ramin in Danau Pulau Besar-Danau Bawah Wildlife Sanctuary, with the purpose to establish a basic data for population viability monitoring in the future and also to determine important information on the microhabitat characteristics. This information hopefully, will be beneficial for determining the management strategy for ramin’s conservation in the future.

MATERIALS AND METHODS

Study area

The study was conducted on December 5-17th 2007; in peat swamp forest of Danau Pulau Besar/Danau Bawah Wildlife Sanctuary (DPB-DW), Riau Province ($00^{0}35'$ – $00^{0}45'$ N and $102^{0}10'$ – $102^{0}19'$ E) with a total area about 28,238 ha. The study area lies on the elevation of 2-6 m asl with slope area range from 0^{0} to 3^{0}. According to Schmidt Fergusson's climate type, this area is considered as type A climate, with a total rainfall of 2,200-2,600 mm per year. The average air temperature each year is 26.2^{0}C; with maximum and minimum temperature about 32.4 and 21.7^{0}C, respectively. The average air moisture is about 84%, with maximum value of 97% and minimum of 60% (Anon, 2000).

Forest in the study area can be categorized as old secondary forest. The vegetation was dominated by *Shorea teysmaniana, Parastemon urophyllum* and *Callophyllum inphylloides*. Meanwhile, *Ganua motleyana*, *Mellanorrhea* sp. and *Goniothalamus giganteus* were also in abundance (Anon, 2000). *Gonystylus bancanus*, even though not as abundant as the other species, was not very difficult to encounter.

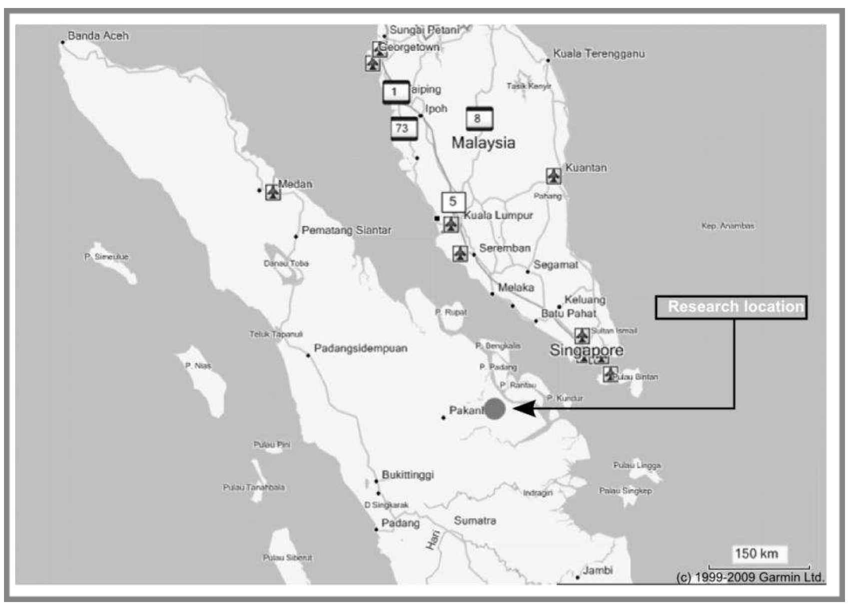

Figure 1. Research location in Danau Pulau Besar and Danau Bawah Wildlife Sanctuaty in Riau Province.

Study Species

Gonystylus bancanus (Miq.) Kurz is a tree species up to 42 m high and 30-120 cm in diameter. A well-marked one, recognized with many knee-roots (pneumatophores), small and rigidly coriaceous leaves which folded together along the midrib, and with much less conspicuous nerves than most Gonystylus species. This species is distributed mainly in the West of Malesia, from SW. Malay Peninsula, SE. Sumatra, Banka and Borneo. It is found mostly in the lowland freshwater coastal swamps forest, which subject to periodic inundation or non-inundated areas, up to 100 m (Airy Shaw, 1954).

Population Density

An extensively Line Intercept method was established to detect the occurrence of *ramin* trees (Krebs, 1999). A baseline of transect which randomly located individual was established. For each plant, the longest perpendicular width was estimated. This width determines the probability that any individual plant will be bisected by the sampling line which will be used to estimate the population size of the plant (Krebs, 1999). All individuals were also recorded using GARMIN Global Positioning System and mapped into GARMIN MAPSOURCE software. Numbers of individuals were enumerated to estimate the population density. Tree diameter and tree height were measured by measurement tape and clinometers to describe the population structure.

Microhabitat Characteristics

To investigate the microhabitat characteristics, 46 plots of ca. 100 m^2 were applied with at least one individual of ramin centered within the plot. Environmental parameters were measured in each plot sample; these were including altitude (obtained using altimeter), slope (measured with Suunto clinometers), soil relative humidity (RH) and soil pH (obtained using soil tester), peat depth (measured using wooden stick and measurement tape), and canopy cover (ocular estimation by eyesight).

Data Analysis

Individual numbers obtained from the transects were calculated into the following parameter: (1) Total individual (the number of trees in a certain area) (2) Density (the number of trees of the species divided by the total area surveyed). All calculations were performed using Ecological Methodology software developed by J.C Krebs (Krebs, 1999). This calculation was purposed to estimate individual numbers of *ramin* per hectare area. The results were compared with previous research or survey conducted in the same study site and other peat swamp areas.

Discriminant Function Analysis (DFA) was employed to analyze the microhabitat characteristics. DFA was purposed to identify variables that explain microhabitat characteristic according to its diameter class. Tree diameter class (TD) was distinguished as below:

1. Group 1: stem diameter range between 15-30 cm
2. Group 2: stem diameter range between 30-45 cm
3. Group 3: stem diameter above 45 cm.

All the statistical process was performed using SPSS 15 (SPSS Inc.)

RESULTS AND DISCUSSION

Population density

In this study we found 48 individuals of *Gonystylus* spp on eight line transects with a total of 8.049 km length. Those were belong to ramin (44 individuals with dbh >20 cm and 2 individuals with dbh.<20 cm), and other *Gonystylus* species (2 individuals). The estimated population density of *ramin* was 7.18 individuals/ha with standard error of 2.75.

Population density of ramin in DPB-DW was higher than in Sungai Tuan-Sungai Suruk Forest, West Kalimantan which estimated about 1.48 individuals/ha (Heriyanto & Garsetiasih, 2006). This area was under the concession of PT. Tri KAKA, therefore presumably most of individuals were already cut down during logging operation. In 2002, FWI reported that in Sebangau Watershed (currently Sebangau National Park, Central Kalimantan) the population density of *ramin* was estimated about 2 individuals/ha which was also lower than in the DPB-DW. Illegal logging had been identified as the major threat.

Nonetheless, higher population density of *ramin* had been reported in Tanjung Puting National Park (Central Kalimantan) with an estimation of about 17 individuals/ha (FWI, 2002). Whereas, according to Chua (2008) the population density of *ramin* in Loagan Bunut National Park (Sarawak) was relatively high about 10 individuals/ha. It showed that, protection and regular monitoring in the both national parks might be the main reason of higher population density of *ramin* in those areas.

This study in DPB-DW also revealed that the population density was higher than previous study in the same area by FWI (2002). FWI found the density of ramin was about 3 individuals/ha, while in this study, the density was two times higher. This increasing number was reasonable, mainly because of its status as a protected area. Moreover, the existence of Oil Company, BOB PT. Bumi Siak Pusako-Pertamina Hulu, may gave an advantage to the sustainability of the population. Their activities which undergo every day were indirectly providing security to the forest.

However, the existence of such an oil company also has some negative impacts to the peat swamp ecosystem. The oil company usually built a canal on each side of established railway in the peat swamps forest. These canals means to avoid flooding on the railway, but it will cause the peat swamps forest being drain. In long term, it can the peat swamp in this area loss it ecological and environmental functions. According to Rieley (1992), tropical lowland peat swamps perform vital ecological and environmental function related to hydrology (e.g. water storage, flood control and fisheries). Andriesse (1992) also asserted that the undisturbed peat swamps may be more important to humans than if drained and developed for short-term profit production that results in irreversible damage to the peat swamps ecosystem.

The ramin population structure represented by size-class (height and dbh) showed a nearly J-shaped curve distribution (Figure 2 and 3). The larger ramin tree with dbh > 35 cm and height > 20 m accounted for more than 69% and 82% respectively. There are almost none seedlings that were found. This means that the regeneration did not perform well. The survivability of the seedlings was very low.

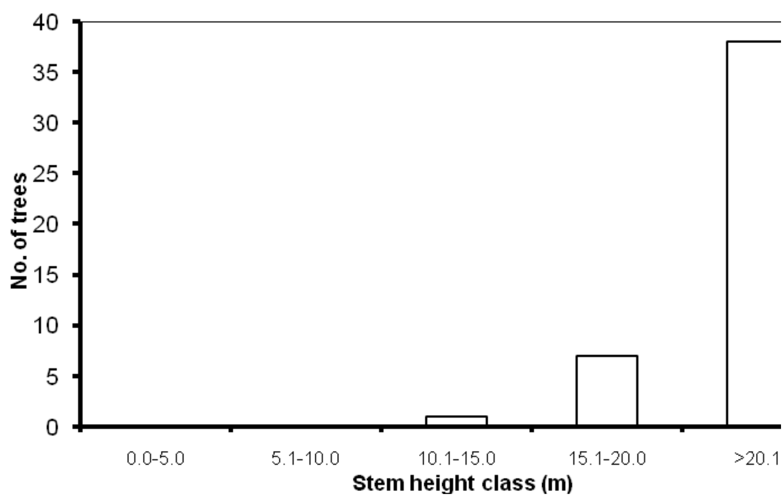

Figure 2. The height class distribution of *ramin* in the study area (n=46).

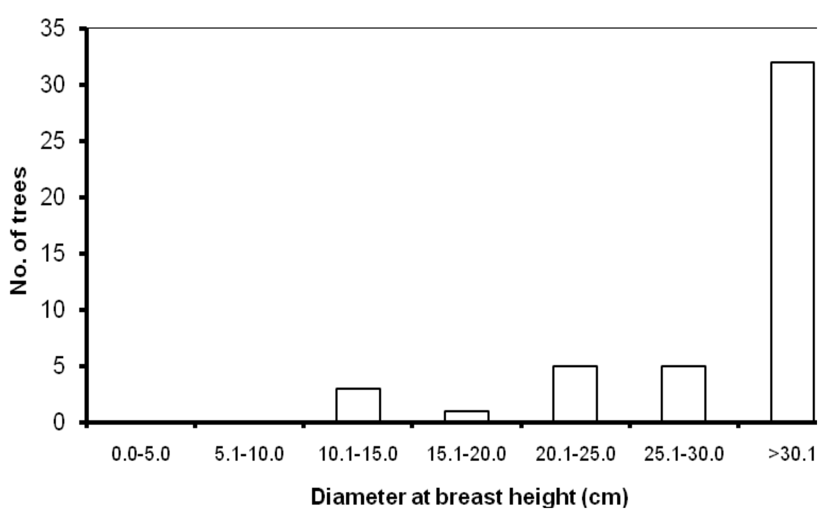

Figure 3. The dbh class distribution of *ramin* in the study area (n=46).

Partomiharjdo (2005) also reported a similar situation of population structure in Diamond Raya Timber Concession area. In the Concession area, their population structure showed a J-shaped curve with fewer seedlings and saplings but with abundance of mature individuals. No seedlings of *ramin* were found in DPB-DW might be correlated to the flowering time and the time when this study was conducted.

Ramin has been known to have irregular flowering season (Airy Shaw, 1954). Dibor (2005) reported in 2002-2003, *ramin* in Lingga (Sri Aman) and Naman Forest Sanctuary (Sibu), Sarawak also have an irregular flowering season with one heavy fruiting season was followed by sporadic or no fruiting in the following years. While in Western Kalimantan, flowering and fruiting season occured in May-June to November (Airy Shaw, 1954), in Central Kalimantan was in April to May (Kartiko, 2002). During the study time in December, there were any flowering trees that found in the study area.

Other possibility is the unsuccessful germination process. Germination process of *ramin* on the forest floor might be poor due to rapid insect and fungal infestation, and also during the seedling regeneration. In addition, high predation on young and immature fruit of *ramin* by bats and squirrels, and predation on freshly germinated seedlings were occur frequently as reported by Dibor (2005) and Shamsudin (1996) and this has exacerbated the situation.

Microhabitat Characteristics

The discriminating function results a correct classification about 89.1% of all the cases. Summary result of discriminant function analyses for each group also showed that only three of six variables examined that contributed significantly to the discrimination among groups (Table 1). Temperature gave dominant contribution to the grouping which followed by slope and soil humidity, respectively.

Table 1. Discriminant Function Analysis Summary

N= 46	Wilks'	Partial	F-remove	p-level	Toler.	1-Toler.
Alt	0.482734	0.875076	2.712395	**0.079227**	0.782335	0.217666
Slope	0.427356	0.988470	0.221621	0.802247	0.848430	0.151570
SRH	0.428214	0.986491	0.260196	0.772263	0.783062	0.216938
SPH	0.444167	0.951058	0.977752	0.385419	0.865501	0.134499
PD	0.441668	0.956440	0.865332	0.429040	0.869020	0.130980
CC	0.590249	0.715679	7.548220	**0.001736**	0.911247	0.088753

A canonical analysis yielded two significant functions that represent six microhabitat variables. The first root corresponds to altitude and soil PH with 95.86% cumulative probability while the second root corresponds to slope, soil humidity, peat depth and canopy cover with 1% cumulative probability. A dispersion plot of the six microhabitats characteristics defined by two roots (Figure 3) showed a significant grouping where each groups of *ramin* was placed in separate area, except for group 1 and group 2.

Over all, *ramin* microhabitat characteristics can be defined into three groups (Table 2). Group 1, consisted of *ramin* with high diameter and height which bears the highest altitude, slope and lowest canopy cover. Group 2, consisted of *ramin* with intermediate diameter and height, altitude, slope, peat depth and canopy cover. And the last group consisted of low diameter and height which bears the lowest altitude, slope, soil humidity and soil PH.

Table 2. Microhabitat Characteristics of Three Groups of *ramin* in DPB-DW

Groups	Factor score of tree diameter and height	Alt	Slope	SRH	SPH	PD	CC	Valid N
G_1:1	>1	24.33±0.99	13.88±1.98	94.44±3.48	05.34±0.18	119.44±9.91	00.00±7.18	8
G_2:2	-1 to 1	23.06±0.54	12.13±1.08	95.93±1.90	05.39±0.10	111.31±5.42	17.66±3.93	24
G_3:3	<-1	18.00±1.13	09.64±2.25	03.95±3.95	05.14±0.20	127.50±11.23	63.57±8.14	14

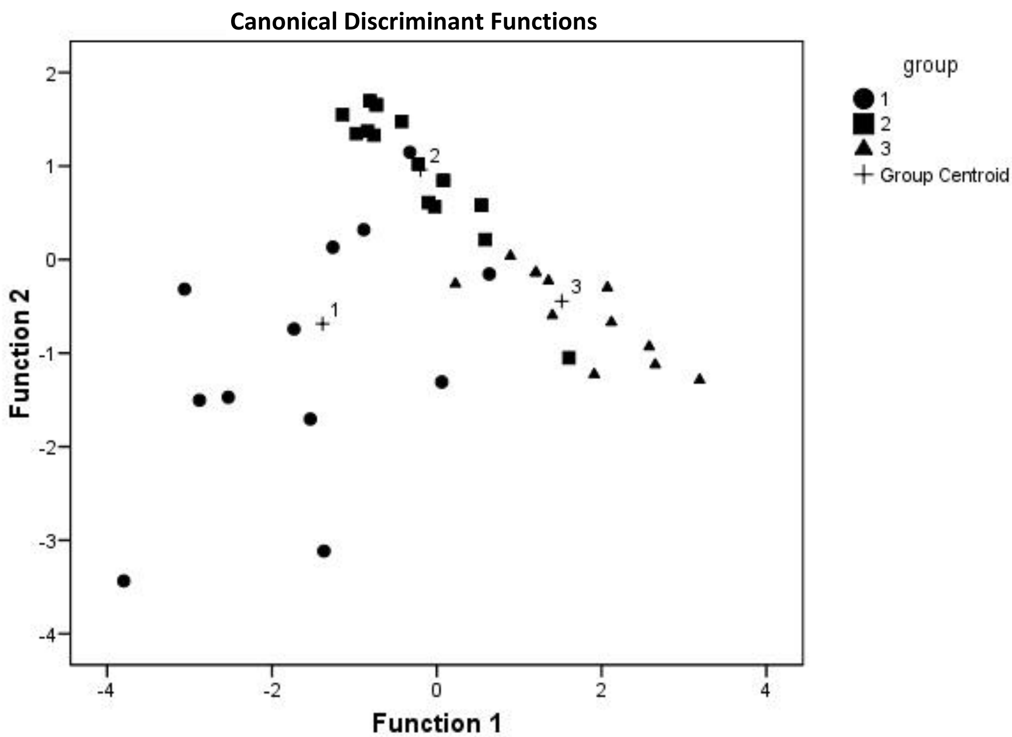

Figure 4. Canonical analysis plot of the *ramin* groups studied for microhabitat characteristics.

Ramin is known to have a specific habitat type that is only restricted to tropical peat swamp forests (Chua, 2008). Tuah *et al.* (2000) and Truong (2005) also reported a positive relationship occurred between percentage of nitrogen in the soil and the presence of *ramin* in peat swamp of Sarawak. Ismail (2009) found that the distribution of *ramin* in Pekan Forest Reserve, Pahang is highly related to peat depth. Obviously, deep peat of more than 6 m is preference of the species to dominate the areas with about 25 stems/ha of 10 cm dbh and above. In this study, we found that *ramin* in term of diameter and tree height has correlations with altitude and soil PH (Table 1). Higher altitude and lower soil PH related to higher tree diameter and height and conversely. But, no significant result was found for peat depth even there is possibility to be related.

CONCLUSION

It is crucial to maintain the natural peat swamp forest for the conservation of *ramin*. Therefore, the conservation in site should be put on a priority due to the dependency of the microhabitat. Moreover, regular population monitoring is also very important and urgently needed in order to understand its population dynamic due to its low natural regeneration. Ex situ conservation such as botanic garden collection and seed bank is also essential as the last fortress to conserve this species.

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